RESEARCH PROPOSAL

Public Health Infrastructure in Rajasthan: An Inter-district Analysis

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List of Abbreviations

Abbreviations	Meaning
IMR	Infant Mortality Rate
TFR	Total Fertility Rate
CHC	Community Health Centre
PHC	Primary Health Centre
SC	Health Sub Centre
CMHO	Chief Medical and Health Officer
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy
CV	Coefficient of Variation
CAGR	Compound Annual Growth Rate
NHRM	National Rural Health Mission
ANC	Ante-natal Checkup
JSY	Janani Suraksha Yojna
ICDS	Integrated Child Development Scheme

INTRODUCTION

A global transformation in human health that has been witnessed that has led people to live longer, healthier and more productive lives. Good health is an important determinant of economic growth and a component of wellbeing of the population. Better health is central to human happiness and well-being. It makes an important contribution to economic progress, as healthy population live longer, are more productive and save more.

Concept of Health Infrastructure

The term physical infrastructure in health has a much broader meaning. It includes not only healthcare centers, dispensaries, or hospitals but also well trained staff with a service perspective. Thus the aim of a health care system is to provide healthcare facilities to the people, thereby improving their health status. Demographic indicators such as infant mortality rate, death rate and birth rate are dependent to a large extent on the availability of healthcare facilities.

The health and well being of the people of the country depends on a well developed, equitable and accessible health infrastructure. Health infrastructure is important for understanding healthcare policy and welfare mechanism in a country. Public health infrastructure provides communities, states and the nation, the capacity to prevent diseases, promote health and prepare for and respond to both acute threats and chronic challenges to health. Infrastructure is the foundation for planning, delivering, evaluating and improving public health.

Public health care system deserves the highest priority in any country, particularly in developing world. WHO (2000) has emphasized that the primary goal of a

health system should be to provide better health in a responsible manner and with fair public expenditure. Development of health infrastructure ensures a country of healthy manpower for production of goods and services. It is the responsibility of the government to ensure the right to healthy living to its citizens.

Health infrastructure in India

With a population of 1.2 billion growing at the rate of 1.1 percent (Census 2011), India will be the most populous nation by 2030, with as many as 1.4 billion or more inhabitants. India has made considerable progress in the area of health over the years as witnessed by various health indicators. Life expectancy at birth has increased, infant mortality and crude death rates have been greatly reduced, diseases such as small pox, polio and guinea worm have been eradicated, and leprosy has been nearly eliminated. The country strives towards achieving Universal Health Coverage.

India's Public Health System is a three tier system namely Primary, Secondary and Tertiary levels of health care, which aims to develop as well as deliver health care services to the individuals and community as a whole.

Primary Health Care	**Secondary Health Care**	**Tertiary Health Care**
↓	↓	↓
Sub- Health Centre Primary Health Centre	Community Health Centre District Hospital/Sub-Divisional	Medical College Apex Centre

The data obtained from National Health Profile 2018 depicting vital statistics dealing with birth rate, death rate, and natural growth rate, life expectancy at birth, mortality and fertility rates are as follows -

- The sex ratio of India during 1901 was 972. Since then, it has continued to decline decade over decade to 926 in 1991. The sex ratio has however improved in 2001 and 2011 which was 933 and 943 respectively.
- There has been consistent decrease in the birth rate, death rate and natural growth rate in India since 1991 to 2016. In 2016, India has registered birth rate of 20.4 per 1000 population and Death Rate of 6.4 per 1000 population while the Natural Growth Rate was 14.0 per 1000 population in India. The Birth Rate in rural areas was higher than in the urban areas and so were the Death Rate and Natural Growth Rate
- The Life Expectancy at Birth has increased from 49.7 years in 1970-75 to 68.3 years in 2011-15. For the same period, the Life Expectancy for Females is 70.0 years and 66.9 years for Males.
- India has registered a significant decline in Infant Mortality Rate. IMR of India has declined from 37 per 1000 live births in 2015 to 34 per 1000 live births in 2016. However differentials of rural & urban are still high.
- The Total Fertility Rate (TFR) for the country was 2.3 whereas in rural areas it has been 2.5 and it has been 1.8 in urban areas during 2016.

The National Health Profile 2018 shows the following condition of health infrastructure development in India -

- Medical education infrastructure in the country has shown rapid growth during the last few years. The country has 476 medical colleges, 313 Dental Colleges for BDS & 249 Dental Colleges for MDS during 2017-18.
- There are 23,582 hospitals having 7, 10,761 beds in the country. 19,810 hospitals are in rural area with 2 ,79,588 beds and 3,772 hospital are in Urban area with 43,1,173 beds as on 31st March, 2017

- Medical care facilities under AYUSH by management status i.e. dispensaries & hospitals are 27,698 and 3,943 respectively as on 1.4.2017.

There exist wide inter-state and intra-state disparities in economic as well as human development in India. Besides this, the inequalities in health among states and among different regions/districts of the big states like Uttar Pradesh, Bihar, Madhya Pradesh etc. remains a matter of deep concern. The widening of this disparity in the period of reforms is further complicating problems for the planners. To provide equitable access to the healthcare services and to continuously raise the standards of healthcare services must be the twin goals of the government.

Health infrastructure in Rajasthan

Rajasthan, physically the largest state in the Indian Union is situated in the north-west part of the country, and has 56 million (or 5 per cent) of the country‘s population. The population density is 165 persons per sq. km. (as against the national average of 312). The decadal growth rate of the state is 28.41 per cent (against 21.54 per cent for the country), and the population of the state continues to grow at a rate much faster than the national rate. Rajasthan is divided into six zones covering 33 Districts, 237 blocks and 41,353 villages. The state is largely rural and 80 per cent of the population is dependent on agriculture for livelihood.

Baseline of public health system in Rajasthan –

- Public Health Infrastructure – According to **4th Common Review Mission of the National Rural Health Mission Rajasthan (2011),** there are 7 medical colleges, 34 district hospitals, 12 sub district hospitals, 5 satellite hospitals, 376 CHCs, 199 dispensaries, 11487 SCs. There are gaps in health infrastructure in the state. Tribal areas lack the requisite numbers of PHCs,

while desert and general areas lack both the requisite numbers of CHCs and PHCs. There is however, no reported gap in the number of sub centers (SCs).

- Human resources - Although within the NRHM process, as per the **4th Common Review Mission of the National Rural Health Mission Rajasthan(2011)**, there has been considerable increase of human resources for health, specifically in recruitment of Accredited Social and Health Activists (ASHAs); the state continues to report significant gap between required and posted health functionaries at all levels specially in rural medical officers, junior and senior specialists, nurses, ANMs and laboratory technicians. Vacancies are present in almost all levels of hierarchy, however, the most significant vacancies are noted for junior and senior specialists (851 posts vacant), senior medical officers (225 posts vacant), medical officers (763 posts vacant), and rural medical officers (424 posts vacant). Additionally, across the state, 15 posts for the deputy chief medical officer remain unfilled. This situation reflects that the state is yet unable to fulfill its role in providing quality health services to majority of people as it is expected to under the NRHM. Similarly, that there remains significant vacancy for nurses (2,186), ANMs (1,731), laboratory technicians (457) and other staff (2,880) as on 1.1.2011

Health Infrastructure disparities

Disparities in Health sector can be determined through proper allocation of available resources and utilization as well as demand for health care needs.

Equitable health care is possible through proper resource allocation and access to health care is determined by health needs. Rajasthan, despite being an economically developing state of India, is suffering from the problem of disparities in public health infrastructure. Under the **DISTRICT LEVEL HOUSEHOLD AND FACILITY SURVEY (2012-13)**, a total 989 SHCs were surveyed from 32 districts in Rajasthan depicting the following findings about inter-district disparities -

- Out of the 989 Sub-Health Centres average population covered by a SHC is 4005. The highest average population covered (6642) among the surveyed SHCs is in Dausa district and the lowest (2552) in Jaisalmer district and it is slightly lower as per prescribed in the government norms.
- Eighty One percent of SHCs have their own government building. Apart from Kota which has only 52.3 percent of the SHCs owning government buildings, all other districts has more than 60 percent of their SHCs working from government buildings etc.
- Bikaner, Jaisalmer, Jalore, Pali and Kota have more than 80 percent SHCs with ANM in position. 26.8 percent of the SHCs in the state are having additional ANMs in positon. It is highest in Banswara district having additional ANM while Churu does not having additional ANMs

Such a grim situation of inter-district disparities in public healthcare infrastructure may be attributed to many underlying factors, which includes inadequate budgetary provisions, administrative mismanagement, shortage of human resource, infrastructural inefficiency and the complacency unwillingness of the government among all.

Review of Literature

Anand (2019) attempted to measure the extent of the inequality in health status and health care services in the two most populous states of India namely Uttar Pradesh and Bihar. A detailed analysis of inter-district and inter-region disparity in health status and health in the two states has been done using secondary data from Annual Health Survey (2011) and Statistical Diary (2011).Composite indices of health status and health services have been developed using Maher's normalization technique and principal component analysis. Inequality measures like co-efficient of variations have been used to measure the relevant disparities in the two states and explain the reason thereof. The study finds health status is influenced not only by health care facilities, but a number of other factors principally government's commitment and policies.

Naveen (2019) analyzed the district wise health infrastructure development of Haryana in 2016-17. UNDP deprivation index method for analyses of district wise health infrastructure development has been used in the study. Further, districts are classified into developed(D), moderately developed(MD) and less developed(LD) category on the basis of values of index. The study shows that health infrastructure development in the state concentrated mainly in 9 districts of the west-south part of Haryana. The study also shows the divergent health infrastructure development in the state and is a serious issue of concern.

Goel and Garg (2018) in their study constructed Health Infrastructure Index in Haryana using an Econometric Approach. On the basis of the available data taken from various issues of Statistical Abstract of Haryana, fourteen indicators of health infrastructure are considered for the period of twenty one years from 1991-92 to 2011- 12. First of all, the collected data is analyzed by computing descriptive

statistics which reveal that seven indicators of health infrastructure possess positive compound annual growth rate (CAGR) while seven others have negative CAGR and certain indicators have experienced high variations in their number over the years. Next, normalization of data is done and then by applying principal component analysis (PCA), composite index for health infrastructure is constructed in various steps including correlation matrix, KMO measure and Bartlett's test; eigenvalues of components; component loading matrix; calculation of weights for variables (indicators of health infrastructure) and finally health infrastructure index. As per index scores, ranks are given to the State for its health infrastructure for all twenty one years. It is found that health infrastructure in Haryana for the year 2004-05 have attained rank 1st with index score 1.000, followed by 2011-12 with score 0.837 and the year 2003-04 having the value of 0.764.

Newar and Sharma (2017) examined regional disparities at district level in the state of Rajasthan, at two points of time 1991-92 to 2010-11. For this purpose six indicators have been selected from agriculture sector and respective composite indices have been prepared and then districts are ranked on the basis of their composite index. The paper suggested that in agriculture sector in Rajasthan more concentrated efforts are needed so that regional disparities at district level captures a declining trend instead of the rising trend at present (though marginally).For this, there is a need to propose a comprehensive plan as per agro-climatic zones of the state taking each district as a major unit.

Bala(2016) in her study is primarily concerned with the analyzing the spread of Public Health Services across the State of Haryana and to examine the inter-District disparities in area of health indicators. In this study data from secondary sources like statistical abstract of Haryana and Data from HMIS portal has been

used and composite index for estimation of District wise disparities have been used. The composite index has been computed by taking average value of all the indictors may be called as deprivation indicators. Study witnessed from the data analysis of health infrastructure over a period of time and other indicators of health that despite the steady improvements in the overall health and HMIS indicators of the Haryana State, there is wide disparities among the few of the district. These districts experience a lower quality of health services and are less likely to receive routine medical procedures and have higher rates of morbidity and mortality than non-minorities.

Garg and Gupta (2014) attempted to examine the inter-district disparities in health infrastructure in Haryana. For this purpose, 10 indicators of heath infrastructure are selected and their COV, Ratios and Deprivation and Development Indices are worked upon. Statistical value of COV confirms the gap in the availability of health facilities in various districts of Haryana. Finally, the deprivation as well as development indices of health infrastructure reveal the discrepancies in districts with regard to health infrastructural development

Ghosh (2013) studied Public Health Services and Health Insurance in West Bengal with Special Reference to Darjeeling District. The study used various primary and secondary data and mathematically analyzed them using Logit analysis, multiple regression model, Pearson's correlation coefficients, $\chi 2$ test. It is found that West Bengal's performance had always been better than all-India averages with regard to most of the vital statistics and in infrastructure development.

Masarguppi and Karne (2013) made an attempt to study the reasons of disparity in 19 states of India for three sectors- Agriculture, Industry, Service sector

including infrastructure. The paper has used Multi-stage Principal Component Analysis to identify the factors contributing to inter -state disparity and thus prepared Composite Index of Economic Growth in order to measure the extent of disparity. Total 9 indicators for each sector – Agriculture, Industry, Service sector including infrastructure were selected and further were divided into Indicator I and indicator II for each sector. For agriculture sector Indicator I included five indicators representing agriculture performance and Indicator II included four indicators representing land utilization. For Industrial sector Indicator I represented industrial sector performance and included 5 indicators and indicator II represented industrial sector productivity which included four indicators. For service sector indicator I represented Sector Performance and included 4 indicators and indicator II represented Infrastructural Performance and included 5 indicators. The results of the study have shown that every state needs to identify its "Lead' sector which ensures backward and forward linkages for other sectors to grow and thus enhancing the overall growth of the state.

Siddu and Murthy(2012) discussed the status and infrastructure with respect to health in Karnataka. Further, they examined regional disparity in health infrastructure and status have been discussed along with public expenditure on health sector. In the present study, the relativity index method and weighted index method have been used to construct the HII and HIS. Based on the Ranks of HII and HIS, the following conclusions drawn are Bangalore Urban tops in HII and Dakshina Kannada district tops in HSI. All the top 5 districts in HII are from South Karnataka viz. Bangalore Urban, Bangalore rural, Chikkaballapur, Kodagu and Udupi, whereas, all the bottom 5 districts are from North Karnataka viz. Bagalkot, Belgaum, Bijapur, Gulbarga and Raichur; and three, among the top 5 districts in

HSI, except Belgaum, the remaining districts viz. Dakshina Kannada, Udupi, Shimoga and Bangalore urban are from South Karnataka.

Kumari (2011) in her paper attempted to measure inter-district disparity in education and health attainment in UP at two time periods 1990-91 and 2007-08. It uses Maher's methodology (subsequently used by a number of others) to standardize 8 indicators for the health attainment and 13 for educational attainment and then applies principal component analysis to compute the composite indices. The results show that apart from existence of wide disparity there are sufficient proof to say that there are regions/districts that have done well in educational attainment but are poorly placed in terms of health attainment and vice-versa. The paper offers some suggestions to reduce the glaring disparity.

Tiwari and Mathur (2010) studied inter-regional economic disparities in Rajasthan. The secondary data has been taken from publication of the Directorate of Economics and Statistics, Government of Rajasthan. A number of method have been used to measure inter-regional economic disparities as (a) Rajkishore Meher's Composite Index of Development (1999), (b) Shastri's Composite Index (1997), (c) Modified Principal Component Analysis Technique of Debroy and Bhandari (2002).The study concluded on Inter-Regional Economic disparities was undertaken with the main objective to measure inter-district inequalities prevalent in various sectors of the economy and livelihood to take necessary measures to reduce inter-regional inequalities.

Gómez-Limon and Riesgo (2008) in order to measure global sustainability of agriculture sector had carried out a comparative analysis of alternative methods on constructing composite. The study had done an empirical case study on the

irrigated agriculture of the Duero basin (Spain) as a case study and have constructed composite indicator based on Principal Component Analysis technique

Rout(2007) attempted to analyze the inter-district availability of health infrastructure in Orissa through the construction of Composite Index of Health Infrastructure (CHI) and suggested some policy measures for better health outcomes in the State. Study concluded that availability of health infrastructure is the necessary condition for a good health outcome but not the sufficient condition.

Sundar and Sharma (2002) in their paper have dealt with the morbidity and Utilization of Healthcare Services of Urban poor in Delhi and Chennai. In this study they examined the pattern of morbidity and healthcare utilization by the urban poor living in the slums and resettlement colonies in the above mentioned two cities and compared the health status of the two segments.

Kurian (2000) talked about widening regional disparities in India in terms of selected socio-economic indicators. The paper had shown that the efforts made by India during the first three decades of the Indian Republic had only partially succeeded in reducing regional disparities. The accelerated economic growth since the early 1980s and 1990s economic reform policies with increased participation by the private sector seems to have aggravated regional disparities.

Coulombe and Day (1999) compared evaluation of regional disparities in per capita income in Canada and 12 American states along Canada's southern border.

The study analyzed the evaluation of regional income disparities over a time period 1929-95 on the basis of personal income per capita. The study had shown decline in regional dispersion in Canada relative to northern states on the basis of the phenomenon of capital accumulation as described by the neoclassical growth model. The locational and labour force participation decisions were found to be main reasons for existing disparities which was further influenced by many other factors explained in paper.

Suneetha (1998) studied inter district variations and determinants of health indices in the state of Kerala. Step-wise regression analysis is used to determine the relative impact of various predictor variables on the outcome of the interest. Various results were obtained for the health status indices for the given time period.

Research Objectives

The main aim of this study is to analyze the inter-district availability of and variability in health infrastructure in Rajasthan .The specific objectives of the study are –

1. To study the demographic, economic and health profile of Rajasthan state and compare it with that of India.
2. To describe the public health infrastructure in Rajasthan on the basis of individual indicators.
3. To study the regional disparities in public health infrastructure of Rajasthan on the basis of selected indicators.
4. To identify the factors behind the existence and growth of inter-district disparities in public health infrastructure in Rajasthan**.**

5. To analyze the inter-linkages between public health infrastructure and health outcome.

Research Questions

1. Has there been a change in the extent of inter-district disparities in public healthcare services in the state over the study period?
2. Are there any inter-linkages between public health infrastructure and health outcome?
3. Is there any correlation between inter-district disparities in public health infrastructure development and other economic development indicators?

Methodology

The study will be based on secondary data collected from various sources –

- Statistical Abstract of Rajasthan
- Basic Statistics of Rajasthan
- Some Facts About Rajasthan published annually by the Directorate of Economics and Statistics (DES), Government of Rajasthan, Jaipur
- District Level Household Survey (DLHS-III)
- National Sample Survey (NSS) Reports
- Census Reports
- Rural Health Statistics Reports
- Various issues of Economic Review

District level data for different variables will be chosen keeping in the view the availability of information.

To pursue the **first objective**, the following approach will be followed. The descriptive analysis of the demographic, economic and health indicators of Rajasthan with that of India will be done , according to Census 2001 and 2011 will give the insights about the socio-economic and health profile of the State of Rajasthan.

To achieve the **second objective**, 18 major indicators will be selected from time period 1993-94 to the latest year for which data is available. They are as follows-

Infrastructure	Broad ingredients	Indicators (No. of)
Allopathic Institutions	Medical institutions	1. Hospitals 2. PHC 3. Dispensaries 4. CHC 5. Sub centers 6. Aid post 7. SHC and MHC
	Medical staff	8. Doctors 9. Nurses 10. Other Staff
	Others	11. Beds
AYUSH Institutions	Medical Institutions	12. Ayurvedic Institutions 13. Unani Institutions 14. Homeopathic Institution
	Medical staff	15. Vaidyas 16. Compounders
	Others	17. Mobile unit 18. Beds

Minimum, Maximum, Range, Mean, Standard deviation, CV and CAGR (%) will be calculated for Rajasthan state.

To achieve the **third objective,** following 22 indicators will be used –

Components	Indicators
Use of and access to health facilities	1. % of safe delivery 2. % of institutional delivery 3. % of full immunization 4. % of full ANC
Indoor treatment infrastructure	1. Total indoor patients treated 2. Beds per lakh of population
Health infrastructure facilities	1. Allopathic Institution : • No. of hospitals • No. of CHC • No. of PHC • No. of Dispensaries • No. of Doctors • Total Medical Staff 2. AYUSH Institution : • No. of Hospitals • No. of Dispensaries • No. of Hakims • No. of Homeopathic Doctors • No. of Ayurvedic Doctors 3. No. of Maternity and Child Welfare Center 4. No. of Mobile Units

Promotive Infrastructure	1. No. of Villages that have implemented JSY 2. No. of Villages with Rogi Kalyan Samiti (RKS) 3. No. of Health facility within village - ICDS (Anganwadi)

Following framework will be used –

Most of the analysis will be based on Principal Component Analysis (PCA), which is the technique used to arrive at the weights. IBM SPSS Statistics will be utilized to apply the technique. Other major calculations will be completed manually as well as by using Microsoft Excel.

The composite Health Infrastructure Development Index (HIDI) will be prepared for any two point of time for every district and obtained HIDI for each district will then be used to find out relative position of district. In order to prepare composite HIDI procedure to be used is described in following section-

- Normalization of Indicators of Health Infrastructure –

  As a preliminary step of constructing an index, normalization is required when the data is obtained in different measurement units to convert it into identical measures. The given data will be normalized by using a 'Linear Scaling Technique' also called 'Min-Max Normalization'. In this way, the normalized data comes up within a limit of 0 to 1.

  $$\text{Normalized Value} = \frac{\text{Indicator value- Minimum value}}{\text{Maximum value – Minimum value}}$$

- Principal Component Analysis for Composite Index –

Principal component analysis of the normalized data will be performed with the help of SPSS and resultant output is shown under following headings-

1. **Correlation Matrix, Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's Test** –

   To start the analysis, it is necessary to test that whether present data is adequate for principal component analysis (PCA). In this regard, Correlation matrix (showing scores of correlation among variables), Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity are computed by SPSS.

2. **Decision for Number of Components -**

   After passing the above tests, next step is to identify the number of factors or principal components or latent variables that can represent all originally undertaken variables. For the same, eigen value-one criterion (Kaiser's criterion or latent root criterion), scree- plot and total amount of variance extracted are the methods that can be used.

3. **Component Matrix and Loadings -**

   Component loadings are the correlations between variables and the latent components. These are used to examine which component is formed with which of the variables. This information is provided by PCA in its output named initial or un-rotated component loading matrix.

4. **Composite Index –**

   To prepare composite index, firstly, each indicator or variable (normalized) for various years is multiplied by its weight and is

divided by its standard deviation (obtained from normalized data). In this way all variables will be credited with weighted scores for various years which have to be summated to obtain composite index for a year.

Classification of districts will be done according to index obtained that would categorized the district into 3 categories- Highly developed (more than 0.5), Medium developed (0.5-0.25) and Low developed (less than 0.25).

To achieve the **fourth objective**, correlation between health infrastructure and economic indicators such as per capita income , education etc. will be analyzed using the statistical method of correlation which will assess the association between the economic indicators and health infrastructure and step wise forward regression analysis will be used to determine the relative impact of various variables on the health infrastructure in Rajasthan.

To achieve the **fifth objective ,** a descriptive analysis will be done .

Tentative Chapter Scheme

1. Introduction
2. Review of Literature
3. Review of Health Indices in Rajasthan
4. Analysis of Health Infrastructure Growth in Rajasthan
5. Inter- district disparities in Health Infrastructure in Rajasthan
6. Policy Implications
7. Conclusions, suggestions and summary

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